1,144,410

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,144,410

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Int. Cl.:—B 21 b 31/08

COMPLETE SPECIFICATION

Roll Changing Apparatus

We, BLAW-KNOX COMPANY, a Corporation organised under the laws of the State of Delaware, United States of America, of 300 Sixth Avenue, Pittsburgh, State of Pennsylvania, 15222, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to roll changing apparatus and is concerned with apparatus for changing rolls of a rolling mill.

The invention provides roll changing apparatus for a rolling mill, comprising a carrier having a socket for receiving the end of a roll to support the roll in cantilever fashion, a guideway which constrains the carrier from tipping with respect thereto, and a drive arrangement for moving the carrier along the guideway.

This apparatus enables the speedy and efficient changing of rolls yet may be relatively simple and inexpensive.

The roll changing apparatus may be adapted for the changing of any rolls of a rolling mill. However, the rolls which require most frequent changing are the work rolls as distinguished from the back-up rolls in mills of the type having back-up rolls.

The carrier preferably includes a plurality of sockets for receiving the ends of the rolls, which are arranged so that the carrier may remove a roll while carrying the replacement roll.

The socket may be disposed in a tiltable part of the carrier so that upon tilting of the tiltable part with the end of a roll in the socket, the carrier can compensate for the droop of the roll so that the roll is supported from its end in cantilever fashion with its axis substantially horizontal.

In a preferred embodiment a device is provided in the socket for clamping the end of a rolling mill roll.

The carrier may have two sockets, one above the other, for receiving a pair of rolling mill rolls and may be adapted to be moved to deliver the rolls together while supported from said ends in cantilever fashion. One socket may be movable with respect to the second socket of the pair.

In another aspect of the roll changing apparatus the carrier may have a part turnable about a vertical axis said part having the socket or sockets for receiving at least one rolling mill roll.

At least the part of the carrier which has the sockets is preferably movable to different elevations for alignment with the rolls to be changed. Preferably a screw mechanism is employed for raising and lowering such part.

In one embodiment of the invention there is provided means for stowing the carrier below the level of the rolling mill floor when the roll changing apparatus is not in use. A portion of the guideway, which when the roll changing apparatus is in use is disposed in horizontal alignment with the remainder of the guideway, is preferably lowered with the carrier when the roll changing apparatus is not in use.

Means may be provided for stowing the carrier and replacement rolls held by the carrier below the level of the rolling mill floor.

In the accompanying drawings we have shown certain presently preferred embodiments of the invention in which

Figure 1 is a more or less diagrammatic elevational view of roll changing apparatus, the rolls, roll stand and roll support being shown in dotted lines, certain positions of the carrier being indicated in chain lines;

Figure 2 is an enlarged side elevational view of the carrier and a portion of the means for lowering and raising the carrier between operative and stowed positions, with parts in vertical cross-section;

Figure 3 is a horizontal cross-sectional view taken on the line III—III of Figure 2;

[*Price 4s. 6d.*]

Figure 4 is a view partly in end elevation and partly in vertical cross section of the apparatus shown in Figure 2;

Figure 5 is a fragmentary detail cross-sectional view taken on the line V—V of Figure 3;

Figure 6 is a fragmentary side elevational view of a carrier head with wedge devices;

Figure 7 is an end elevational view of the structure shown in Figure 6; and

Figure 8 is a fragmentary cross-sectional view to enlarged scale taken on the line VIII—VIII of Figure 6.

Referring now more particularly to the drawings, Figure 1 indicates in dotted lines a roll stand 2 for a 4-high rolling mill having work rolls 3 and back-up rolls 4. The mill may be conventional in all respects as well known to those skilled in the art.

The floor level of the mill is indicated at 5. The roll changing apparatus when in operative position is disposed partly below and partly above the floor level and provision is made for stowing it entirely below the floor level when not in use.

Below the mill floor level 5 is a relatively shallow elongated pit extending toward the roll stand 2 from a roll support separate from the roll stand and shown in the drawings as comprising a roll supporting car 6 mounted on a track 7. The relatively shallow elongated pit is designated 8. Adjacent the roll stand 2 the relatively shallow elongated pit 8 communicates with a relatively deep pit 9. In the pit 8 is a fixed guideway 10 comprising opposed outwardly open channels and in alignment with the guideway 10 in the pit 9 when the roll changing apparatus is in operative position is a guideway 11 mounted on a platform 12 guided for vertical up and down movement in the pit 9 and thus movable by a piston in a cylinder 13 which is connected with the platform 12 by a rod 14. When the roll changing apparatus is in operative position the guideway 11 is in horizontal alignment with the guideway 10 as mentioned above and as shown in Figure 1. When the roll changing apparatus is not in use the platform 12 is moved down into the pit 9 and the guideway 11, being mounted on the platform 12, is correspondingly lowered.

Supported on the guideway 11 for movement therealong is a carrier 15 having wheels 16 disposed in the guideway 11 as shown in Figure 4 so that the carrier 15 is guided by the guideway as it moves therealong. When the roll changing apparatus is not in use the carrier 15 is moved to the position indicated by chain lines in Figure 1 and designated A whereupon the platform 12 carrying the guideway 11 and the carrier 15 is moved downwardly in the pit 9 to a position in which the carrier is disposed entirely below the floor level 5 as indicated at B in Figure 1.

Mounted atop the guideway 11 at opposite sides of the center line of the guideway are racks 17 with which mesh pinions 18 driven through suitable connections by an electric motor and gear reducer 19. Fixedly mounted in the pit 8 are racks 20 which when the platform 12 is in the position shown in Figure 1 are in alignment with the racks 17. Thus upon operation of the motor the carrier 15 is moved longitudinally of the guideway 11, and when the guideway 10 is in alignment with the guideway 11 as shown in Figure 1 the carrier 15 may move to any position along the combined guideways 10 and 11, the pinions 18 meshing with the racks 20 when the carrier is disposed on the guideway 10.

Carried by the carrier 15 and disposed with its axis substantially vertical is an element 21 which is splined within a ring gear 22 for up and down axial movement relatively to the ring gear. The element 21 is adapted to be turned about its vertical axis by an electric motor and gear reducer 23 acting through suitable connections as shown to turn the gear 22. Thus the element 21 may be burned about its vertical axis while occupying various vertical positions within the ring gear 22 or indeed while turning with the ring gear 22.

At the bottom of the element 21 is a thrust bearing 24 against which bears the upper end of a screw jack 25 threaded through an internally threaded sleeve 26 fixedly mounted in the frame of the carrier 15. A gear 26*a* is fixed to the screw jack 25 at its bottom and meshes with a wide-faced gear 26*b* which is adapted to be turned through suitable gearing as shown by an electric motor and gear reducer 27. Turning of the gear 26*b* results in turning of the gear 26*a* and consequently of the screw jack 25. Since the screw jack 25 is threaded through the fixedly mounted internally threaded sleeve 26 turning of the gear 26*a* is accompanied by upward or downward movement of the screw jack and hence of the element 21 depending upon the direction in which the gear 26*a* is turned. During upward or downward movement the gear 26*a* moves upwardly or downwardly as the case may be relatively to the wide-faced gear 26*b* which drives it. Thus the screw jack 25 determines the elevation of the element 21 and the ring gear 22 independently determines the angular position of the element 21, neither being affected by the other.

Referring to the embodiment of the invention shown in Figures 1—5, mounted upon the element 21 by a horizontal pivotal connection 28 is a head 29 having laterally facing roll grasping means shown in the drawings as a pair of superposed sockets 30. The element 21 carries a cylinder 31 in which operates a piston 32 connected through a piston rod 33 and a link 34 with an arm 35 integral with the head 29. Operation of the piston 32 and the cylinder 31 tilts the head 29 so that when the ends of rolls are in the sockets 30 the head may be tilted by turning it in the counterclock-

wise direction about the axis of the pivotal connection 28 viewing Figure 2 until the rolls are picked up, being supported by their ends in the sockets 30 in cantilever fashion, the tilting of the head 29 compensating for the droop of the rolls so that the rolls may be supported with their axes substantially horizontal. The guideways 10, 11 constrain the carrier 15 from tipping due to the weight of the rolls.

Figures 6, 7 and 8 show a different form of the invention in which the element 21 supports head 36 having therein four sockets 30 in pairs facing in opposite directions so that a pair of new rolls may be held in one pair of sockets while a pair of rolls to be replaced are removed by the other pair of sockets, whereafter the element 21 may be rotated 180° to present the new rolls for insertion and mounting in the housings. The head 36 may have a plurality of sockets with axes in any direction to facilitate removal and replacement of the rolls. Wedges 37 are disposed in sockets 30 for gripping the ends of work rolls. As shown in Figure 8 each of the wedges 37 is slidably supported in its socket 30 by means of a dovetail interlocking bracket and slot, the wedges being disposed at right angles to each other. Springs 38 urge wedges 37 toward out position. Shoulder 39 of a roll engages the wedges 37 associated with the socket 30 into which the end of the roll is being inserted and moves the wedges inwardly so that they grip the end of the roll, inhibiting droop of the roll. The element 21 as shown in Figures 6, 7 and 8 can remove and replace work rolls by rotating 180° through its vertical axis as above indicated. The roll is released by any outward movement.

When the work rolls 3 of the 4-high mill shown in Figure 1 are to be changed the top back-up roll 4 is raised to free the work rolls 3 and the means mounting the work rolls in the housings are removed or freed so that the work rolls may be moved generally horizontally toward the left viewing Figure 1 out of the housing.

When the work rolls are to be changed the platform 12 is raised to position the carrier 15 in position A of Figure 1. The sockets 30 which are to receive the rolls to be removed are disposed toward those rolls and the elevation of the element 21 is adjusted as required to dispose the axes of the sockets 30 in line with the axes of the rolls to be removed. Then the carrier 15 is moved toward the right viewing Figure 1 to the position indicated by the letter C whereupon the ends of the work rolls 3 are disposed in the sockets 30. Thereupon either clamping means such as the wedges 37 associated with the sockets shown in Figures 6, 7 and 8 are rendered operative or the head 29 is tilted in the counterclockwise direction viewing Figure 2 and/or raised to cause the roll ends to be grasped by the sockets, the tilting of the head 29 compensating for the droop of the rolls. In either case the roll ends are grasped and the rolls supported independently of the housings with the axes of the rolls substantially horizontal. If desired the element 21 may be raised slightly before withdrawing the rolls from the housings although normally that is not necessary as the rolls are raised slightly upon tilting of the head 29.

With the rolls thus supported by the head 29 in cantilever fashion the carrier 15 is moved toward the left viewing Figure 1. After the rolls 3 have cleared the mill housings the element 21 is turned through an angle of 180° about its vertical axis. The element 21 is indicated as having been turned through 90° at the position indicated by the letter D in Figure 1. The turning of the element 21 may occur simultaneously with the movement of the carrier 15 toward the left viewing Figure 1. When the element 21 has been turned through 180° from its initial position the carrier may be moved to the position indicated by the letter E in Figure 1 when the rolls are disposed above the car 6. Thereupon the head 29 may be tilted downwardly or lowered to deposit the rolls on the car. The car may be provided with means laterally embracing the rolls when they are thus deposited so that they will remain in substantially superposed position.

After the rolls have been deposited on the car 6 the carrier 15 may be backed away toward the right from position E viewing Figure 1 until the head 29 clears the roll ends. Thereupon the car 6 may be moved along the track 7 to dispose a new pair of rolls in alignment with the sockets 30 of the head 29. The carrier 15 may be moved toward the left back to position E whereupon the ends of the new rolls are disposed in the sockets 30. The head 29 may then be tilted and/or raised to pick up the new rolls which are supported in the sockets 30 in cantilever fashion as were the original rolls. The carrier 15 may then be moved toward the right viewing Figure 1 through positions D and A to position C during which movement the element 21 may be rotated about its vertical axis through an angle of 180°. The new rolls are disposed in the housings in the position originally occupied by the rolls which were removed whereupon the head 29 may be tilted to release the new rolls and the carrier 15 may be moved from position C to position A and thence to position B. The mill floor is of course provided with a slot through which the element 21 extends while the rolls are being changed. If desired that slot may be covered when rolls are not being changed.

If the structure shown in Figures 6, 7 and 8 is employed and if new rolls are carried by one pair of sockets in the head 36 while the old rolls are being removed by another pair of sockets the new rolls may be inserted and mounted in the housing before the carrier 15 moves to the car 6. Alternatively, the old rolls may be removed before the new rolls are

picked up and the carrier may be moved from the mill to the car 6 carrying the old rolls which have just been removed, the new rolls may be picked up before the element 21 is turned through 180° and thereafter the element 21 may be turned through 180° and the new rolls presented to the mill. Car 6 may therefore be replaced by a fixed stand.

The chocks for the rolls are removed with the rolls and the new rolls are preferably provided with their own chocks. When referring to the rolls in the specification and claims it is to be understood that the chocks may be assembled to the rolls so that the rolls and chocks are removed together and the new rolls are inserted with their chocks.

Thus we provide for changing rolling mill rolls quickly and efficiently with comparatively simple and inexpensive apparatus.

For purposes of explanation and illustration the invention has been described as embodied in roll changing apparatus for changing the work rolls of a 4-high rolling mill. The roll changing apparatus in the form shown in the drawings is adapted for changing at the same time both of the work rolls of a 4-high mill. The apparatus may easily be adapted for the simultaneous changing of the three work rolls of a 3-high rolling mill.

WHAT WE CLAIM IS:—

1. Roll changing apparatus for a rolling mill, comprising a carrier having a socket for receiving the end of a roll to support the roll in cantilever fashion, a guideway which constrains the carrier from tipping with respect thereto, and a drive arrangement for moving the carrier along the guideway.

2. Roll changing apparatus according to claim 1, wherein the carrier has two sockets arranged one above the other whereby a pair of rolls may be supported by the carrier.

3. Roll changing apparatus according to claim 1 or 2, wherein the or each socket is provided on a part of the carrier which is pivoted about a horizontal axis and an adjustable linkage is provided for pivoting said part and setting it at desired positions.

4. Roll changing apparatus according to claim 3, wherein the adjustable linkage comprises a fluid actuator.

5. Roll changing apparatus according to any preceding claim, including a mechanism for raising and lowering a part of the carrier on which the or each socket is provided.

6. Roll changing apparatus according to claim 5, wherein said mechanism is a screw mechanism.

7. Roll changing apparatus according to any preceding claim, including a mechanism for rotating about a vertical axis a part of the carrier on which the or each socket is provided.

8. Roll changing apparatus according to claim 7, having a plurality of sockets arranged to receive and support rolls extending in different directions.

9. Roll changing apparatus according to any preceding claim, wherein the or each socket includes a device for clamping the end of a roll therein.

10. Roll changing apparatus according to claim 9, wherein said device is a wedge movable inwardly and outwardly relative to the socket and spring urged outwardly.

11. Roll changing apparatus according to any preceding claim, wherein the carrier is mounted on a supporting structure which also serves as said guideway.

12. Roll changing apparatus according to claim 11, wherein the supporting structure comprises laterally facing channels in which wheels of the carrier are engaged.

13. Roll changing apparatus according to any preceding claim, wherein said drive arrangement comprises a rack fixed with respect to the guideway, a pinion mounted on the carrier and engaged with the rack, and a motor which drives said pinion.

14. Roll changing apparatus according to any preceding claim, when installed in a rolling mill with the guideway arranged so that the carrier is movable between a position adjacent a roll stand and a roll depositing and pick-up position spaced therefrom.

15. Roll changing apparatus according to claim 14, wherein the carrier is movable onto an elevator mounted in a pit into which the carrier may be lowered on the elevator when not in use.

16. Roll changing apparatus according to claim 15, wherein an end portion of the guideway is mounted on the elevator which together with the pit is adjacent the roll stand.

17. Roll changing apparatus for a rolling mill, constructed and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

18. Roll changing apparatus installed in a rolling mill, constructed, arranged and adapted to operate substantially as herein described with reference to and as illustrated in the accompanying drawings.

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Agents for the Applicants.

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1144410 COMPLETE SPECIFICATION

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Sheet 1

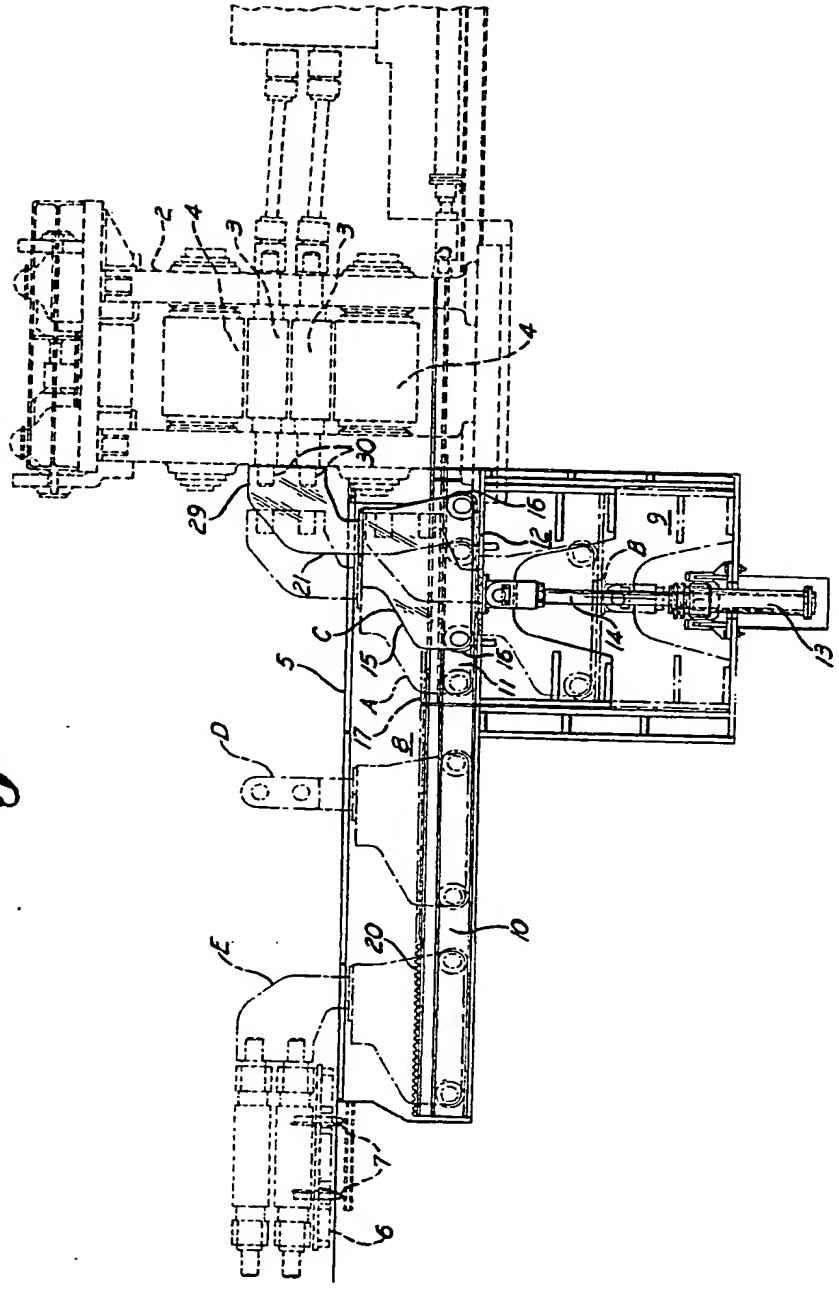

Fig. 1.

Fig. 5.

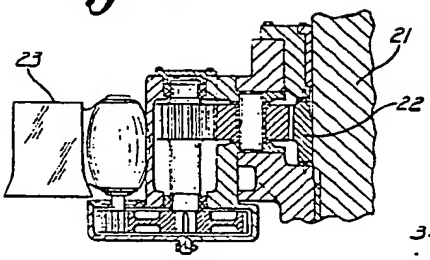
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Fig. 2.

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III
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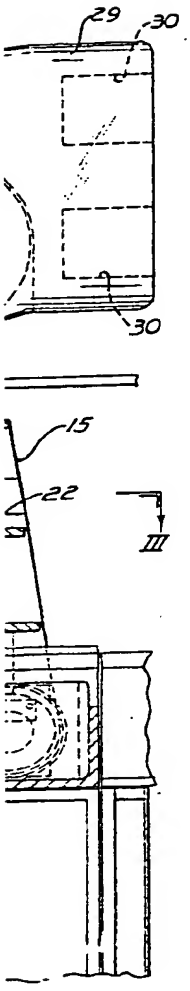

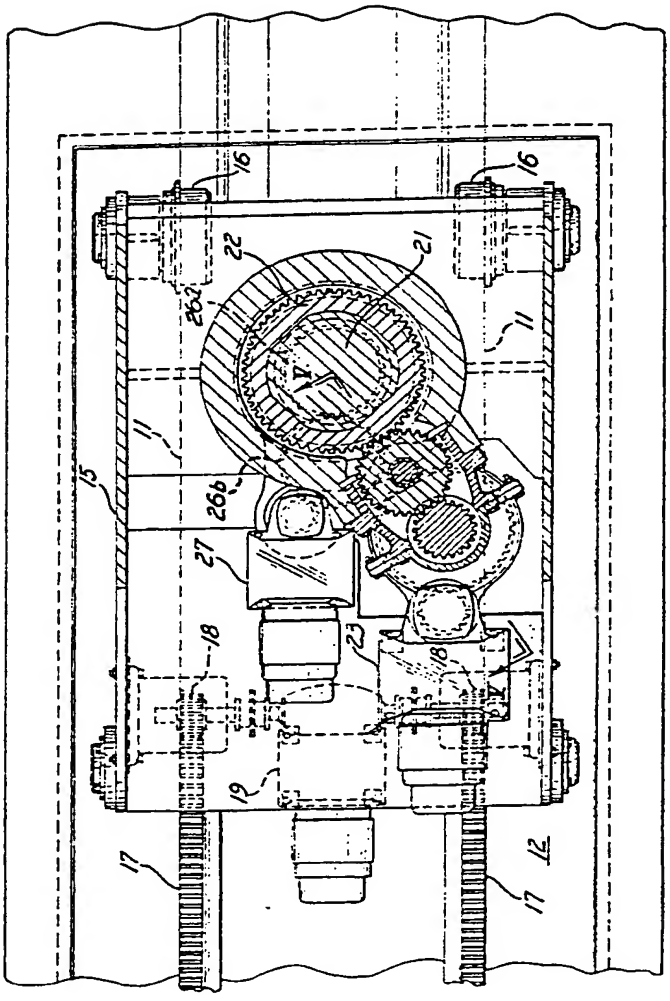

Fig. 3.

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Fig. 5.

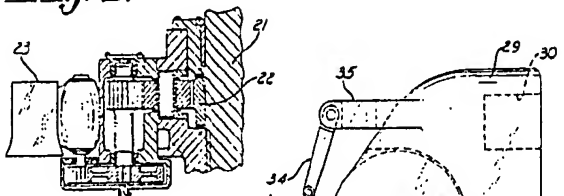

Fig. 2.

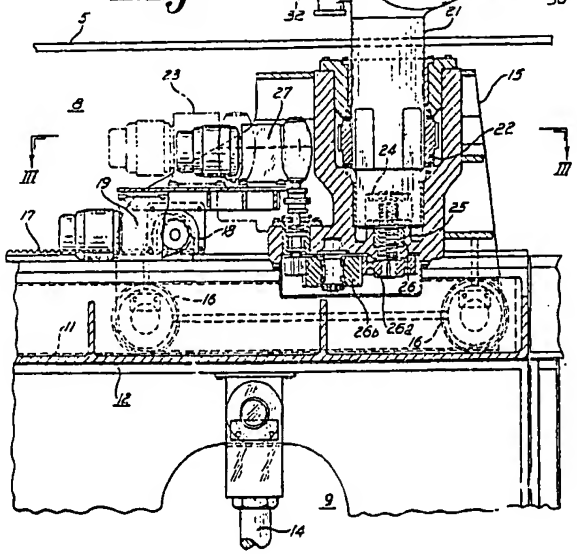

Fig. 3.

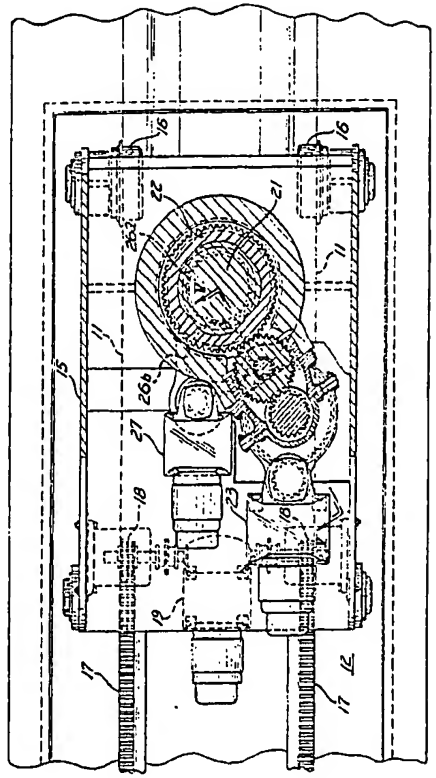

Fig. 4.

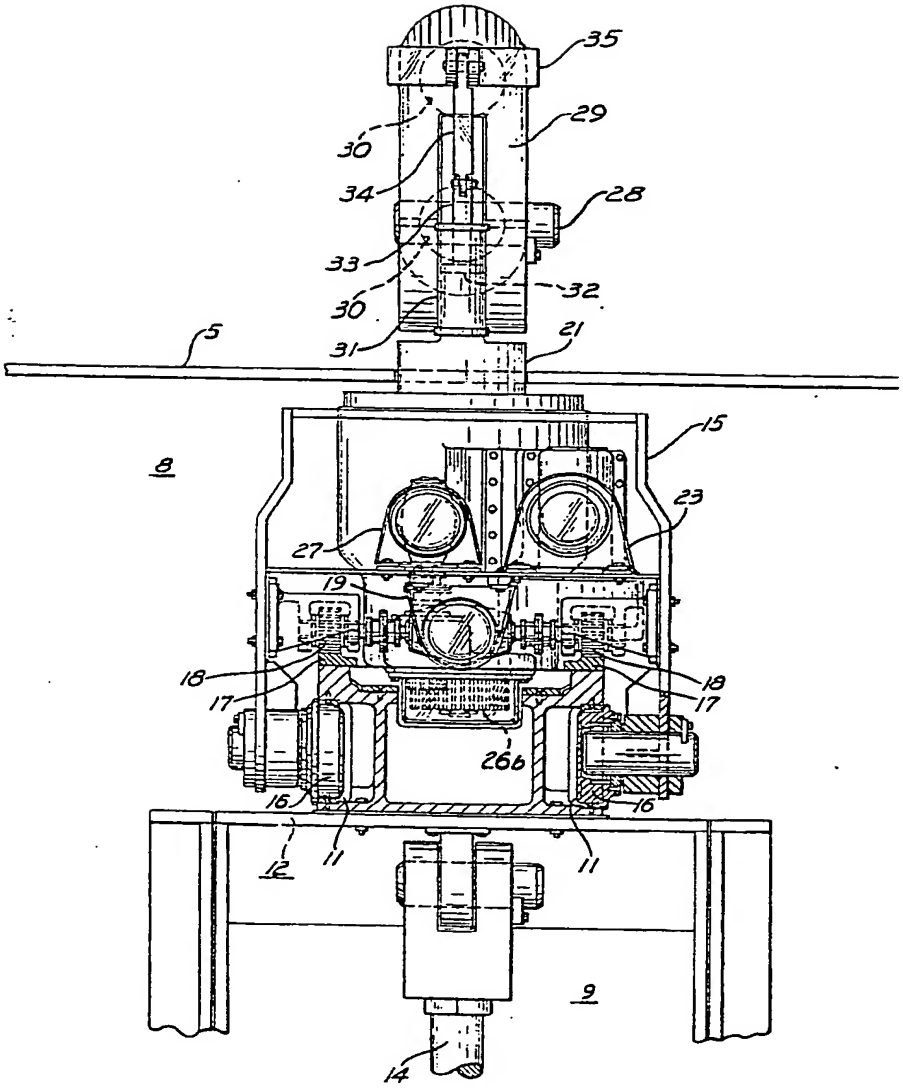

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Fig.6.

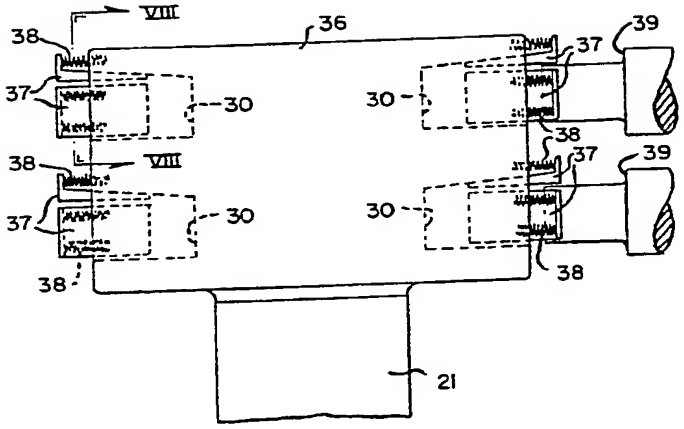

Fig.7.

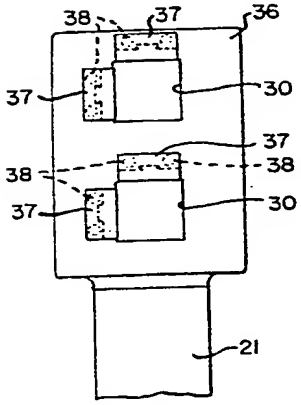

Fig.8.

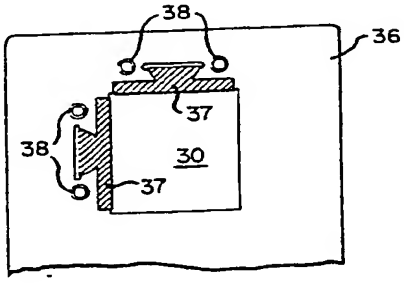

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Fig. 4.

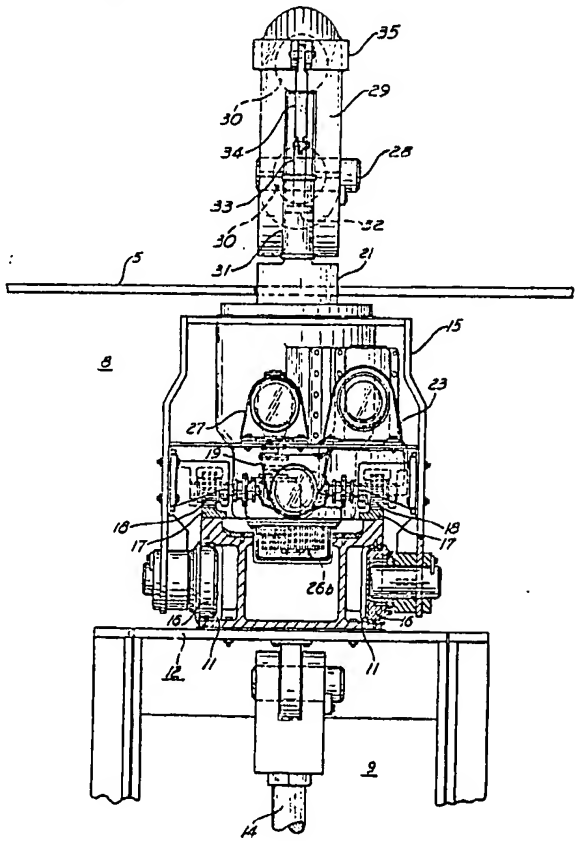

Fig.6.

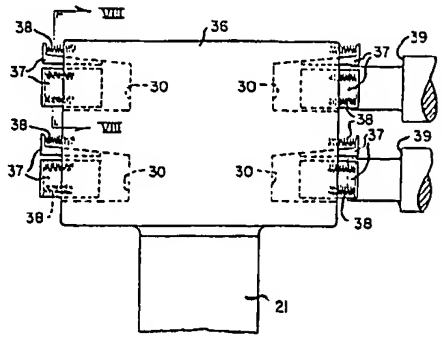

Fig.7.

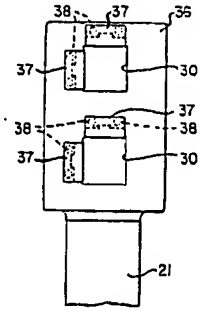

Fig.8.